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REMARKS: **Serial No. 09/865,238, filed May 25, 2001**
Attached hereto is an Appeal Brief.

Total Number of Pages (Including This One): **31**

FROM: Daniel J. Krueger, Direct Dial No. 713/238-8055

DATE: January 10, 2006 ATTORNEY DOCKET NO. 1789-04801

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Application Number	09/865,238
Filing Date	May 25, 2001
First Named Inventor	Nadeem AHMED
Art Unit	2634
Examiner Name	C. Q. Ware
Attorney Docket Number	1789-04801
Total Number of Pages in This Submission	31

ENCLOSURES (Check all that apply)

- [x] Fee Transmittal Form
  - [x] Fee Attached
- [ ] Amendment/Reply
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  - [ ] Affidavits/declaration(s)
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- [ ] Express Abandonment Request
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- [ ] Certified Copy of Priority Document(s)
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FEE TRANSMITTAL
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☑ Applicant claims small entity status. See 37 CFR 1.27

TOTAL AMOUNT OF PAYMENT ($) 250

Complete if Known	
Application Number	09/865,238
Filing Date	May 25, 2001
First Named Inventor	Nadeem AHMED
Examiner Name	C. Q. Ware
Art Unit	2634
Attorney Docket No.	1789-04801

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FEE CALCULATION

1. BASIC FILING, SEARCH, AND EXAMINATION FEES

Application Type	FILING FEES Fee ($)	FILING FEES Small Entity Fee ($)	SEARCH FEES Fee ($)	SEARCH FEES Small Entity Fee ($)	EXAMINATION FEES Fee ($)	EXAMINATION FEES Small Entity Fee ($)	Fees Paid ($)
Utility	300	150	500	250	200	100	
Design	200	100	100	50	130	65	
Plant	200	100	300	150	160	80	
Reissue	300	150	500	250	600	300	
Provisional	200	100	0	0	0	0	

2. EXCESS CLAIM FEES

Fee Description	Fee ($)	Small Entity Fee ($)
Each claim over 20 (including Reissues)	50	25
Each independent claim over 3 (including Reissues)	200	100
Multiple dependent claims	360	180

Total Claims ____ - 20 or HP = **Extra Claims** ____ x **Fee ($)** ____ = **Fee Paid ($)** ____

HP = highest number of total claims paid for, if greater than 20.

Indep. Claims ____ - 3 or HP = **Extra Claims** ____ x **Fee ($)** ____ = **Fee Paid ($)** ____

HP = highest number of independent claims paid for, if greater than 3.

Multiple Dependent Claims **Fee ($)** ____ **Fee Paid ($)** ____

3. APPLICATION SIZE FEE

If the specification and drawings exceed 100 sheets of paper (excluding electronically filed sequence or computer listings under 37 CFR 1.52(e)), the application size fee due is $250 ($125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).

Total Sheets ____ - 100 = **Extra Sheets** ____ / 50 = **Number of each additional 50 or fraction thereof** ____ (round up to a whole number) x **Fee ($)** ____ = **Fee Paid ($)** ____

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SUBMITTED BY			
Signature	[signature]	Registration No. (Attorney/Agent) 44,144	Telephone (713) 238-8000
Name (Print/Type)	Daniel J. Krueger		Date January 10, 2006

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants:	Nadeem AHMED et al.	§	Confirmation No.:	3979
Serial No.:	09/865,238	§	Group Art Unit:	2634
Filed:	May 25, 2001	§	Examiner:	C. Q. Ware
For:	Joint Detection In OFDM Systems	§	Atty. Docket No.:	1789-04801

APPEAL BRIEF

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 23313-1450

January 10, 2006

Dear Sir:

In response to the final office action of September 20, 2005, the appellant files this appeal brief. A notice of appeal was filed via facsimile on December 20, 2005.

TABLE OF CONTENTS

I. REAL PARTY IN INTEREST

The real party in interest is the assignee: Wm. Marsh Rice University.

III. RELATED APPEALS AND INTERFERENCES

Neither the appellant, the appellants' legal representative, nor the assignee know of any other appeals or interferences that will directly affect or be directly affected by or have a bearing on the Board's decision in an appeal on this case.

III. STATUS OF CLAIMS

The status of the claims is as follows:

Originally filed claims:	1-23.
Canceled claims:	None.
Currently rejected claims:	1-9, 11-13, 15-23.
"Objected to" claims:	10, 14.
Presently appealed claims:	1-9, 11-13, 15-23.

IV. STATUS OF AMENDMENTS

An "Amendment After Notice of Appeal" was filed January 9, 2006, to place claims 10 and 14 in independent form without altering the claim scope in any way. The claims appendix assumes entry of this amendment.

V. SUMMARY OF CLAIMED SUBJECT MATTER

The following provides a concise explanation of the subject matter defined in each of the claims involved in the appeal, referring to the specification by page and line number and to the drawings by reference characters, as required by 37 CFR § 41.37(c)(1)(v). Each element of the claims is identified by a corresponding reference to the specification and drawings where applicable. Note that the citation to passages in the specification and drawings for each claim element does not imply that the limitations from the specification and drawings should be read into the corresponding claim element.

Claim 1 recites a communications receiver that includes an analog-to-digital converter 26, a transform module (34 in Fig. 2; alternatively matched bandpass filters in ¶32), and a detection module (38, in combination with 304 (Fig. 3), 402-406 (Fig. 4), or 502-532 (Fig. 5)). The analog-to-digital converter 26 samples a DMT (discrete multi-tone) signal to obtain a digital receive signal (Fig. 2; ¶27ℓ1-2). The transform module is coupled to the analog-to-digital converter 26 to determine amplitudes associated with frequency components of the digital receive signal (¶25ℓ5-6 ("Fourier Transform"); or ¶32 ("matched bandpass filter outputs")). The detection module determines a channel symbol from the amplitudes (38 in Figs. 3-5) while accounting for correlation between the amplitudes (¶32; ¶36; ¶38).

Claim 11 recites a method of receiving OFDM (orthogonal frequency division multiplexing) modulated data. The method includes determining a set of frequency component amplitudes associated with a channel symbol interval of a receive signal (¶25ℓ5-6 ("Fourier Transform"); or ¶32 ("matched bandpass filter outputs")); and determining a channel symbol associated with the set of frequency component amplitudes (38 in Figs. 3-5) while accounting for correlation between the amplitudes (¶32; ¶36; ¶38).

Claim 19 recites a communications system that comprises a transmitter and a receiver. The transmitter transmits an OFDM modulated signal (10-20 in Fig. 1; ¶25-26). The receiver receives and demodulates a corrupted version of the OFDM modulated signal (26-40 in Fig. 2; ¶26ℓ5-¶27ℓ2). The receiver includes an analog-to-digital converter 26, a transform module (34 in Fig. 2; alternatively matched bandpass filters in ¶32), and a detection module (38, in combination with 304 (Fig. 3), 402-406 (Fig. 4), or 502-532 (Fig. 5)). The analog-to-digital converter 26

samples a DMT (discrete multi-tone) signal to obtain a digital receive signal (Fig. 2; ¶27ℓ1-2). The transform module is coupled to the analog-to-digital converter 26 to determine amplitudes associated with frequency components of the digital receive signal (¶25ℓ5-6 ("Fourier Transform"); or ¶32 ("matched bandpass filter outputs")). The detection module determines a channel symbol from the amplitudes (38 in Figs. 3-5) while accounting for correlation between the amplitudes (¶32; ¶36; ¶38).

A notable point regarding each of the independent claims is the requirement of "accounting for correlation between the [frequency domain] amplitudes". As described in ¶32, the embodiment of Fig. 3 accounts for correlation between frequency domain amplitudes by minimizing an equation that includes the effects of correlation between carriers having different frequencies. Fig. 4 shows an illustrative embodiment that accounts for correlation between frequency domain amplitudes by applying multi-carrier filters 402-406 that are at least in part determined based on correlation between carriers having different frequencies. Fig. 5 shows yet another illustrative embodiment that accounts for correlation between time-spaced frequency domain amplitudes using delay elements 510-514, multi-carrier filters 512-516, and adders 502-506 and 518-532. In each of these illustrative embodiments, the frequency domain amplitudes are being processed in a manner that accounts for correlation.

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Appellants seek review of the following grounds of rejection:

1. Claims 1-4, 6, 8-9, 11-13, 16, and 18-22 stand rejected under 35 USC § 103(a) as being unpatentable over "Applicant's admitted prior art" (hereafter "Conventional OFDM") in view of U.S. Patent No. 5,748,677 ("Kumar").
2. Claims 5, 15, and 23 stand rejected under 35 USC § 103(a) as being unpatentable over Conventional OFDM in view of Kumar.
3. Claims 7 and 17 stand rejected under 35 USC § 103(a) as being unpatentable over Conventional OFDM in view of Kumar and further in view of U.S. Patent No. 6,452,981 ("Raleigh").

VII. ARGUMENT

The claims do not stand or fall together. Instead, applicants present separate arguments for various independent and dependent claims. Each of these arguments is separately argued below and presented with separate headings and sub-heading as required by 37 CFR § 41.37(c)(1)(vii).

A. U.S. Patent No. 5,748,677 ("Kumar")

Kumar discloses a system and method for communicating a predetermined reference signal together with a data-modulated signal (Abstract). However, the examiner particularly relies on Kumar's background discussions.

Kumar begins with a discussion of the wireless RF (radio frequency) channel (c1ℓ41-c3ℓ17). Among other things, Kumar notes that the wireless channel causes frequency-dependent amplitude and phase distortion of the transmitted signal (c1ℓ51-59). Kumar describes multipath propagation as a primary cause of distortion in mobile communication systems and notes that the distortion effects vary with frequency (c1ℓ66-c2ℓ12). Kumar then discusses modulation methods that combat multipath propagation, including "spread spectrum" communications (c2ℓ13-24).

Kumar notes that in spread spectrum communications, the transmitted data message is spread across an expanded bandwidth using a spreading signal (c2ℓ18-21). In the receiver, the spreading effect is collapsed by correlating the received signal with the spreading signal (c2ℓ21-23; c11ℓ46-52). This correlation operation happens in the time domain as a summing of products between the received signal and the spreading signal (c11ℓ46-52).

Kumar also describes another wideband communications technique, time division multiplexing (TDM) (c2ℓ24-31), then notes that the robustness of wideband communications methods can be evaluated in terms of a "coherence interval", i.e., the length of time over which multipath delay effects are strongly correlated (c2ℓ32-40). This correlation time is indicative of a minimum bandwidth for a robust wideband communications system (c2ℓ40-44).

Kumar then turns to linear and stochastic models for channels suffering from multipath propagation effects (c2ℓ45-c3ℓ17). Though not explicitly stated, these models may suggest that multipath propagation channels create time-domain correlation in the received signals.

Kumar then enters into a discussion of the utility of reference signals and describes block diagrams of existing systems that employ reference signals, most of which is unimportant here (c3ℓ18-c12ℓ57). Kumar mentions in passing that a reference signal may be chosen to be orthogonal to a subcarrier signal, allowing the signals to be separated using a correlation operation (c7ℓ7-10). (As before, this correlation operation is performed in the time domain.) This separation is possible because orthogonal signals are uncorrelated (c7ℓ10-12).

In describing the composite signal demodulator 39 (see Fig. 3 below), Kumar describes two illustrative implementations (c11ℓ32-52). In an implementation for an OFDM system, the composite signal demodulator 39 employs a Fast Fourier Transform to perform subcarrier demodulation (c11ℓ41-46). In an implementation for a multiplexed spread spectrum system, the composite signal demodulator 39 employs a (time domain) spreading signal correlator for each subcarrier (c11ℓ46-52).

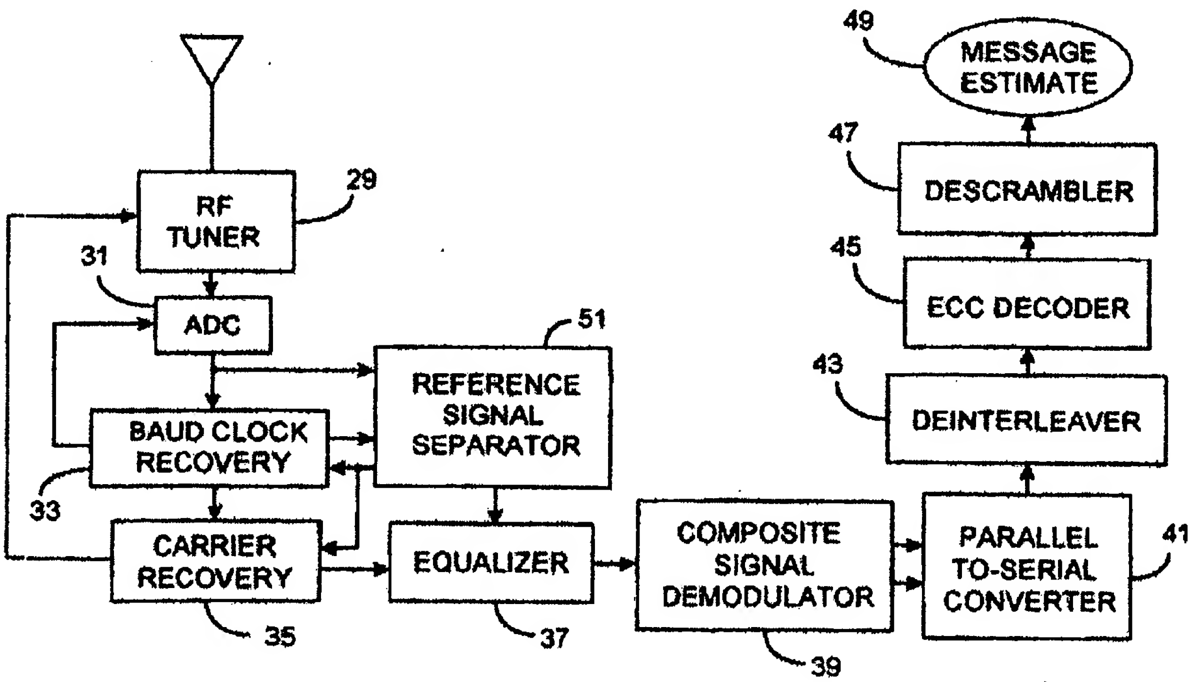

FIG. 3 (PRIOR ART)

B. Rejections Under 35 USC § 103(a) Over Conventional OFDM in view of Kumar

1. Claims 1, 8-9 and 19

Claims 1, 8-9, and 19 stand rejected under 35 USC § 103(a) as being unpatentable over "Applicant's admitted prior art" (hereafter "Conventional OFDM") in view of U.S. Patent No. 5,748,677 ("Kumar"). Appellants respectfully traverse these rejections because the examiner has failed to establish a prima facie case of obviousness, which requires, *inter alia*, that the cited reference must teach or suggest all the claim limitations.

Independent claim 1 recites "a detection module configured to determine a channel symbol from the [frequency component] amplitudes while accounting for correlation between the [frequency component] amplitudes". Independent claim 19 recites a similar limitation. The examiner acknowledges that Conventional OFDM does not disclose this limitation, and cites Kumar's background discussions as teaching a detection module that accounts for correlation.

However, Kumar nowhere teaches or suggests accounting for correlation in the frequency domain as required by claims 1 and 19. To the contrary, Kumar only discusses correlation in the time domain, and even there Kumar's discussions primarily concern the correlation operation for de-spreading a spread spectrum signal, which is not an operation associated with an OFDM or DMT system as recited in claims 1 and 19. For at least these reasons, appellants maintain that the cited art provides absolutely no teaching or suggestion of the above quoted claim limitation, and consequently, that claims 1 and 19, along with dependent claims 8-9, are allowable over the cited art.

2. Claims 2 and 20

Claims 2 and 20 stand rejected under 35 USC § 103(a) as being unpatentable over Conventional OFDM in view of Kumar. Appellants respectfully traverse these rejections because the examiner has failed to establish a prima facie case of obviousness, which requires, *inter alia*, that the cited reference must teach or suggest all the claim limitations.

Claim 2 depends from claim 1 and is allowable for at least the same reasons as claim 1. In addition, claim 2 recites "the detection module determines the most probable channel symbol given the [frequency component] amplitudes determined by the transform module". The examiner cites Kumar at c10ℓ60-67 and c11ℓ32-52. At c10ℓ60-67 Kumar discusses the use of

(time domain) DFE or Viterbi equalization in equalizer 37 to determine a most likely transmitted bit sequence. At c11ℓ32-52, Kumar discusses illustrative embodiments of composite signal demodulator 39. At no point does Kumar teach or suggest a maximum likelihood or maximum probability technique for determining a channel symbol from frequency domain amplitudes. For at least this additional reason, claim 2 is allowable over the cited art.

Claim 20 depends from claim 19 and is allowable for at least the same reasons as claim 19. In addition, claim 20 recites a limitation similar to that of claim 2, and is additionally allowable for at least the same reasons as claim 2.

3. Claims 3 and 21

Claims 3 and 21 stand rejected under 35 USC § 103(a) as being unpatentable over Conventional OFDM in view of Kumar. Appellants respectfully traverse these rejections because the examiner has failed to establish a prima facie case of obviousness, which requires, *inter alia*, that the cited reference must teach or suggest all the claim limitations.

Claim 3 depends from claim 1 and is allowable for at least the same reasons as claim 1. In addition, claim 3 recites "the detection module includes: a weighted sum unit associated with each frequency component". The examiner cites Kumar at c7ℓ4-18, c9ℓ1-6, c10ℓ23-28, c10ℓ63-c11ℓ5, and c11ℓ32-52. The first cite concerns the choice of reference signals that may be orthogonal to subcarrier signals. The second cite concerns the use of a (time-domain) correlation sum to determine a proper sampling point. The third cite concerns the use of minimum mean square estimation (MMSE) to determine coefficients of (time domain) equalizer 37. The fourth cite concerns the use of DFE or Viterbi equalization in (time domain) equalizer 37 to determine a most-likely transmitted bit sequence. The fifth cite concerns illustrative embodiments of composite signal modulator 39, one of which provides a correlator for each subcarrier in a spread spectrum system. At no point does Kumar teach or suggest a weighted sum unit associated with each frequency component in a DMT system. For at least this additional reason, claim 3 is allowable over the cited art.

Claim 21 depends from claim 19 and is allowable for at least the same reasons as claim 19. In addition, claim 21 recites a limitation similar to that of claim 3, and is additionally allowable for at least the same reasons as claim 3.

4. Claims 4 and 22

Claims 4 and 22 stand rejected under 35 USC § 103(a) as being unpatentable over Conventional OFDM in view of Kumar. Appellants respectfully traverse these rejections because the examiner has failed to establish a prima facie case of obviousness, which requires, *inter alia*, that the cited reference must teach or suggest all the claim limitations.

Claim 4 depends from claim 1 and is allowable for at least the same reasons as claim 1. In addition, claim 4 recites "the detection module determines the channel symbol that corresponds to a matrix product of a matrix M and a vector of [frequency component] amplitudes from the transform module, wherein the matrix M minimizes a square of an expected error between the channel symbol and valid channel symbols". The examiner cites Kumar at c10ℓ23-28, c10ℓ63-c11ℓ5, and c11ℓ32-52. The first cite concerns the use of minimum mean square estimation (MMSE) to determine coefficients of (time domain) equalizer 37. The second cite concerns the use of DFE or Viterbi equalization in (time domain) equalizer 37 to determine a most-likely transmitted bit sequence. The third cite concerns illustrative embodiments of composite signal modulator 39, one of which provides a correlator for each subcarrier in a spread spectrum system. At no point does Kumar teach or suggest minimizing a square of expected error in the frequency domain. For at least this additional reason, claim 4 is allowable over the cited art.

Claim 22 depends from claim 19 and is allowable for at least the same reasons as claim 19. In addition, claim 22 recites a limitation similar to that of claim 4, and is additionally allowable for at least the same reasons as claim 4.

5. Claims 6

Claim 6 stands rejected under 35 USC § 103(a) as being unpatentable over Conventional OFDM in view of Kumar. Appellants respectfully traverse these rejections because the examiner has failed to establish a prima facie case of obviousness, which requires, *inter alia*, that the cited reference must teach or suggest all the claim limitations.

Claim 6 depends from claim 1 and is allowable for at least the same reasons as claim 1. In addition, claim 6 recites "a time domain equalizer that operates on the digital receive signal to maximize a percentage of impulse response energy in a predetermined interval". The examiner cites Kumar at c19ℓ36-67, c23ℓ29-36, and c26ℓ9-12. Each of these cites concern an

accumulation function implemented by compensated accumulator 102 (see Fig. 5). The accumulation function operates on multiple cycles of the received reference signal to increase the effective signal to noise ratio (c19ℓ50-55). However, Kumar does not here or elsewhere teach or suggest maximizing a percentage of impulse response energy in a predetermined interval. For at least this additional reason, claim 6 is allowable over the cited art.

6. Claims 11 and 18

Claims 11 and 18 stand rejected under 35 USC § 103(a) as being unpatentable over Conventional OFDM in view of Kumar. Appellants respectfully traverse these rejections because the examiner has failed to establish a prima facie case of obviousness, which requires, *inter alia*, that the cited reference must teach or suggest all the claim limitations.

Independent claim 11 recites "determining a channel symbol associated with the set of frequency component amplitudes while accounting for correlation between the [frequency component] amplitudes". The examiner acknowledges that Conventional OFDM does not disclose this limitation, and cites Kumar's background discussions as teaching a detection module that accounts for correlation. However, Kumar nowhere teaches or suggests accounting for correlation in the frequency domain as required by claim 11. To the contrary, Kumar only discusses correlation in the time domain, and even there Kumar's discussions primarily concern the correlation operation for de-spreading a spread spectrum signal, which is not an operation associated with an OFDM system as recited in claim 11. For at least these reasons, appellants maintain that the cited art provides absolutely no teaching or suggestion of the above quoted claim limitation, and consequently, that claim 11 and its dependent claim 18 are allowable over the cited art.

7. Claim 12

Claims 12 stands rejected under 35 USC § 103(a) as being unpatentable over Conventional OFDM in view of Kumar. Appellants respectfully traverse these rejections because the examiner has failed to establish a prima facie case of obviousness, which requires, *inter alia*, that the cited reference must teach or suggest all the claim limitations.

Claim 12 depends from claim 11 and is allowable for at least the same reasons as claim 11. In addition, claim 12 recites "identifying a channel symbol that is most probably correct

given the set of frequency component amplitudes". The examiner cites Kumar at c10ℓ60-67 and c11ℓ32-52. At c10ℓ60-67 Kumar discusses the use of DFE or Viterbi equalization in (time domain) equalizer 37 to determine a most likely transmitted bit sequence. At c11ℓ32-52, Kumar discusses illustrative embodiments of composite signal demodulator 39. At no point does Kumar teach or suggest a maximum probability technique for identifying a channel symbol from frequency domain amplitudes. For at least this additional reason, claim 12 is allowable over the cited art.

8. Claim 13

Claim 13 stands rejected under 35 USC § 103(a) as being unpatentable over Conventional OFDM in view of Kumar. Appellants respectfully traverse these rejections because the examiner has failed to establish a prima facie case of obviousness, which requires, *inter alia*, that the cited reference must teach or suggest all the claim limitations.

Claim 13 depends from claim 11 and is allowable for at least the same reasons as claim 11. In addition, claim 13 recites "for each frequency component: calculating a weighted sum of frequency component amplitudes that minimizes expected error energy of the frequency component". The examiner cites Kumar at c7ℓ4-18, c9ℓ1-6, c10ℓ23-28, c10ℓ63-c11ℓ5, and c11ℓ32-52. The first cite concerns the choice of reference signals that may be orthogonal to subcarrier signals. The second cite concerns the use of a (time-domain) correlation sum to determine a proper sampling point. The third cite concerns the use of minimum mean square estimation (MMSE) to determine coefficients of (time domain) equalizer 37. The fourth cite concerns the use of DFE or Viterbi equalization in (time domain) equalizer 37 to determine a most-likely transmitted bit sequence. The fifth cite concerns illustrative embodiments of composite signal modulator 39, one of which provides a correlator for each subcarrier in a spread spectrum system. At no point does Kumar teach or suggest a weighted sum calculated for each frequency component in an OFDM system. For at least this additional reason, claim 13 is allowable over the cited art.

9. Claim 16

Claim 16 stands rejected under 35 USC § 103(a) as being unpatentable over Conventional OFDM in view of Kumar. Appellants respectfully traverse these rejections because the examiner

has failed to establish a prima facie case of obviousness, which requires, *inter alia*, that the cited reference must teach or suggest all the claim limitations.

Claim 16 depends from claim 11 and is allowable for at least the same reasons as claim 11. In addition, claim 16 recites "processing the receive signal to shorten the effective channel impulse response". The examiner cites Kumar at c19ℓ36-67, c23ℓ29-36, and c26ℓ9-12. Each of these cites concern an accumulation function implemented by compensated accumulator 102 (see Fig. 5). The accumulation function operates on multiple cycles of the received reference signal to increase the effective signal to noise ratio (c19ℓ50-55). However, Kumar does not here or elsewhere teach or suggest maximizing a percentage of impulse response energy in a predetermined interval. For at least this additional reason, claim 6 is allowable over the cited art.

C. Further Rejections Under 35 USC § 103(a) Over Conventional OFDM in view of Kumar

1. Claims 5 and 23

Claims 5 and 23 stand rejected under 35 USC § 103(a) as being unpatentable over Conventional OFDM in view of Kumar. Appellants respectfully traverse these rejections because the examiner has failed to establish a prima facie case of obviousness, which requires, *inter alia*, that the cited reference must teach or suggest all the claim limitations.

Claim 5 depends from claim 1 and is allowable for at least the same reasons as claim 1. In addition, claim 5 recites "the detection module includes: ... a feedback module that determines a matrix product of a matrix T and the channel symbol from the decision unit to provide the trailing intersymbol interference to the subtraction module". The examiner cites Kumar at c10ℓ31-43 and c11ℓ32-52. The first cite concerns an implementation of equalization module 37 that employs decision feedback equalization (DFE). The second cite concerns illustrative embodiments of composite signal modulator 39, one of which computes a fast Fourier Transform for an OFDM system. At no point does Kumar teach or suggest matrix-based DFE, let alone a feedback module that determines trailing ISI in the frequency domain. For at least this additional reason, claim 5 is allowable over the cited art.

Claim 23 depends from claim 19 and is allowable for at least the same reasons as claim 19. In addition, claim 23 recites a limitation similar to that of claim 5, and is additionally allowable for at least the same reasons as claim 5.

2. Claim 15

Claim 15 stands rejected under 35 USC § 103(a) as being unpatentable over Conventional OFDM in view of Kumar. Appellants respectfully traverse these rejections because the examiner has failed to establish a prima facie case of obviousness, which requires, *inter alia*, that the cited reference must teach or suggest all the claim limitations.

Claim 15 depends from claim 11 and is allowable for at least the same reasons as claim 11. In addition, claim 15 recites "determining a product of a matrix T and the channel symbol to obtain the intersymbol interference in a subsequent set of frequency component amplitudes." The examiner cites Kumar at c10ℓ31-43 and c11ℓ32-52. The first cite concerns an implementation of equalization module 37 that employs decision feedback equalization (DFE). The second cite concerns illustrative embodiments of composite signal modulator 39, one of which computes a fast Fourier Transform for an OFDM system. At no point does Kumar teach or suggest matrix-based DFE, let alone a feedback module that determines trailing ISI in the frequency domain. For at least this additional reason, claim 15 is allowable over the cited art.

D. Rejections Under 35 USC § 103(a) Over Conventional OFDM in view of Kumar and Raleigh

1. Claim 7

Claim 7 stands rejected under 35 USC § 103(a) as being unpatentable over Conventional OFDM in view of Kumar and further in view of U.S. Patent No. 6,452,981 ("Raleigh"). Appellants respectfully traverse these rejections because the examiner has failed to establish a prima facie case of obviousness, which requires, *inter alia*, that the cited reference must teach or suggest all the claim limitations.

Claim 7 depends from claim 1 and hence incorporates the limitations of claim 1. The examiner does not cite Raleigh as teaching or suggesting any limitations of claim 1. Raleigh apparently teaches spatial processing of multiple receive signals, but fails to teach or suggest accounting for correlation between frequency component amplitudes of a single receive signal as

required by the claims. See, e.g., Raleigh c14ℓ54-c5ℓ6 (suggesting that frequency component bins are independent). Thus claim 7 is allowable over the cited art for at least this reason.

2. Claim 17

Claim 17 stands rejected under 35 USC § 103(a) as being unpatentable over Conventional OFDM in view of Kumar and further in view of Raleigh. Appellants respectfully traverse these rejections because the examiner has failed to establish a prima facie case of obviousness, which requires, *inter alia*, that the cited reference must teach or suggest all the claim limitations.

Claim 17 depends from claim 11 and hence incorporates the limitations of claim 11. The examiner does not cite Raleigh as teaching or suggesting any limitations of claim 11. Raleigh apparently teaches spatial processing of multiple receive signals, but fails to teach or suggest accounting for correlation between frequency component amplitudes of a single receive signal as required by the claims. See, e.g., Raleigh c14ℓ54-c5ℓ6 (suggesting that frequency component bins are independent). Thus claim 17 is allowable over the cited art for at least this reason.

E. Allowed claims

The examiner has indicated that claims 10 and 14 would be allowable if written in independent form. In an amendment after notice of appeal, appellants have amended these claims accordingly.

F. Conclusion

For the reasons stated above, appellants respectfully submit that the rejections should be reversed for the reasons given above. Appellants believe that they have complied with each requirement of the appeal brief. If any member of the Board of Appeals has any questions or otherwise feels it would be advantageous, he is encouraged to telephone the undersigned at (713) 238-8055.

In the course of the foregoing discussions, appellant may have at times referred to claim limitations in shorthand fashion, or may have focused on a particular claim element. This discussion should not be interpreted to mean that the other limitations can be ignored or dismissed. The claims must be viewed as a whole, and each limitation of the claims must be considered when determining the patentability of the claims.

Appl. No. 09/865,238
Appeal Brief dated January 10, 2006
Reply to Office Action of September 20, 2005

It is believed that no extensions of time or fees are required, beyond those that may otherwise be provided for in documents accompanying this paper. However, in the event that additional extensions of time are necessary to allow consideration of this paper, such extensions are hereby petitioned under 37 CFR § 1.136(a), and any fees required (including fees for net addition of claims) are hereby authorized to be charged to Conley Rose, P.C. Deposit Account Number 03-2769/1789-04801/HDJK.

Respectfully submitted,

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VIII. CLAIMS APPENDIX

1. (Original) A communications receiver that comprises:

an analog-to-digital converter that samples a DMT (discrete multi-tone) signal to obtain a digital receive signal;

a transform module coupled to the analog-to-digital converter and configured to determine amplitudes associated with frequency components of the digital receive signal; and

a detection module configured to determine a channel symbol from the amplitudes while accounting for correlation between the amplitudes.

2. (Original) The receiver of claim 1, wherein the detection module determines the most probable channel symbol given the amplitudes determined by the transform module.

3. (Original) The receiver of claim 1, wherein the detection module includes:

a weighted sum unit associated with each frequency component, wherein each weighted sum unit combines a plurality of amplitudes from the transform module in a manner designed to minimize any error between the output of the weighted sum unit and a valid output value.

4. (Original) The receiver of claim 1, wherein the detection module determines the channel symbol that corresponds to a matrix product of a matrix M and a vector of amplitudes from the transform module, wherein the matrix M minimizes a square of an expected error between the channel symbol and valid channel symbols.

5. (Original) The receiver of claim 1, wherein the detection module includes:

a subtraction module that removes trailing intersymbol interference from the output of the transform module to obtain ISI-corrected frequency component values;

a decision unit that determines a matrix product of a matrix M and a vector of ISI-corrected frequency component values to obtain the channel symbol; and

a feedback module that determines a matrix product of a matrix T and the channel symbol from the decision unit to provide the trailing intersymbol interference to the subtraction module.

6. (Original) The receiver of claim 1, further comprising:

a time domain equalizer that operates on the digital receive signal to maximize a percentage of impulse response energy in a predetermined interval.

7. (Original) The receiver of claim 1, further comprising:

a cyclic prefix remover that removes prefixes from the digital receive signal, each prefix being associated with a respective channel symbol.

8. (Original) The receiver of claim 1, further comprising:

an error correction code decoder that decodes channel symbols received from the detection module.

9. (Original) The receiver of claim 1, wherein the transform module performs a fast Fourier Transform (FFT) on the receive signal in each channel symbol interval.

10. (Previously presented) A communications receiver that comprises:

an analog-to-digital converter that samples a DMT (discrete multi-tone) signal to obtain a digital receive signal;

a transform module coupled to the analog-to-digital converter and configured to determine amplitudes associated with frequency components of the digital receive signal; and

a detection module configured to determine a channel symbol from the amplitudes while accounting for correlation between the amplitudes,

wherein the transform module includes a bank of matched bandpass filters.

11. (Original) A method of receiving OFDM (orthogonal frequency division multiplexing) modulated data, wherein the method comprises:

determining a set of frequency component amplitudes associated with a channel symbol interval of a receive signal; and

determining a channel symbol associated with the set of frequency component amplitudes while accounting for correlation between the amplitudes.

12. (Original) The method of claim 11, wherein said determining a channel symbol includes:

identifying a channel symbol that is most probably correct given the set of frequency component amplitudes.

13. (Original) The method of claim 11, wherein said determining a channel symbol includes:

for each frequency component:

calculating a weighted sum of frequency component amplitudes that minimizes expected error energy of the frequency component.

14. (Previously presented) A method of receiving OFDM (orthogonal frequency division multiplexing) modulated data, wherein the method comprises:

determining a set of frequency component amplitudes associated with a channel symbol interval of a receive signal; and

determining a channel symbol associated with the set of frequency component amplitudes while accounting for correlation between the amplitudes, wherein said determining a channel symbol includes:

determining a product of a matrix M and the set of frequency component amplitudes, wherein the matrix M includes at least two non-zero values in each row.

15. (Original) The method of claim 11, wherein said determining a channel symbol includes:

subtracting intersymbol interference from the set of frequency component amplitudes to obtain an ISI-corrected set of frequency component amplitudes;

determining a product of a matrix M and the ISI-corrected set of frequency component amplitudes to obtain the channel symbol; and

determining a product of a matrix T and the channel symbol to obtain the intersymbol interference in a subsequent set of frequency component amplitudes.

16. (Original) The method of claim 11, further comprising:

processing the receive signal to shorten the effective channel impulse response before performing said determining a set of frequency component amplitudes.

17. (Original) The method of claim 11, further comprising:

removing a prefix from each symbol interval of the receive signal before performing said determining a set of frequency component amplitudes.

18. (Original) The method of claim 11, wherein said determining a set of frequency component amplitudes includes:

converting the receive signal into digital form; and

performing a fast Fourier Transform on the digital receive signal.

19. (Original) A communications system that comprises:

a transmitter that transmits an OFDM modulated signal; and

a receiver that receives and demodulates a corrupted version of the OFDM modulated signal, wherein the receiver includes:

an analog-to-digital converter that samples the corrupted OFDM-modulated signal to obtain a digital receive signal;

a transform module coupled to the analog-to-digital converter and configured to determine amplitudes associated with frequency components of the digital receive signal; and

a detection module configured to determine a channel symbol from the amplitudes while accounting for correlation between the amplitudes.

20. (Original) The system of claim 19, wherein the detection module determines the most probable channel symbol given the amplitudes determined by the transform module.

21. (Original) The system of claim 19, wherein the detection module includes:

a weighted sum unit associated with each frequency component, wherein each weighted sum unit combines a plurality of amplitudes from the transform module in a manner designed to minimize any error between the output of the weighted sum unit and a valid output value.

22. (Original) The system of claim 19, wherein the detection module determines the channel symbol that corresponds to a matrix product of a matrix M and a vector of amplitudes from the transform module, wherein the matrix M minimizes a square of an expected error between the channel symbol and valid channel symbols.

23. (Original) The system of claim 19, wherein the detection module includes:

a subtraction module that removes trailing intersymbol interference from the output of the transform module to obtain ISI-corrected frequency component values;

a decision unit that determines a matrix product of a matrix M and a vector of ISI-corrected frequency component values to obtain the channel symbol; and

a feedback module that determines a matrix product of a matrix T and the channel symbol from the decision unit to provide the trailing intersymbol interference to the subtraction module.

IX. EVIDENCE APPENDIX

Not applicable.

X. RELATED PROCEEDINGS APPENDIX

Not applicable.